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B63B 35/44 25/08

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GB 2292349 A GB 2121733 A GB 1585922 A

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(54) Semi-Submersible Vessels

(57) A semi-submersible vessel for storing liquid hydrocarbons comprises a superstructure 12 and six spaced apart legs 14 extending from said superstructure. Each said leg is divided by internal wall means 28 which define storage tank means (not visible) spaced radially inwardly of the respective leg. The legs 14 are rigidly interconnected at end portions thereof disposed remote from said superstructure by a ring pontoon 26. Means are provided for communicating liquid hydrocarbons to said storage tank means. The pontoon defines ballast tank means 48 which is adapted to receive sea water and/or house a permanent ballast having a density greater than sea water, eg concrete or drilling mud.

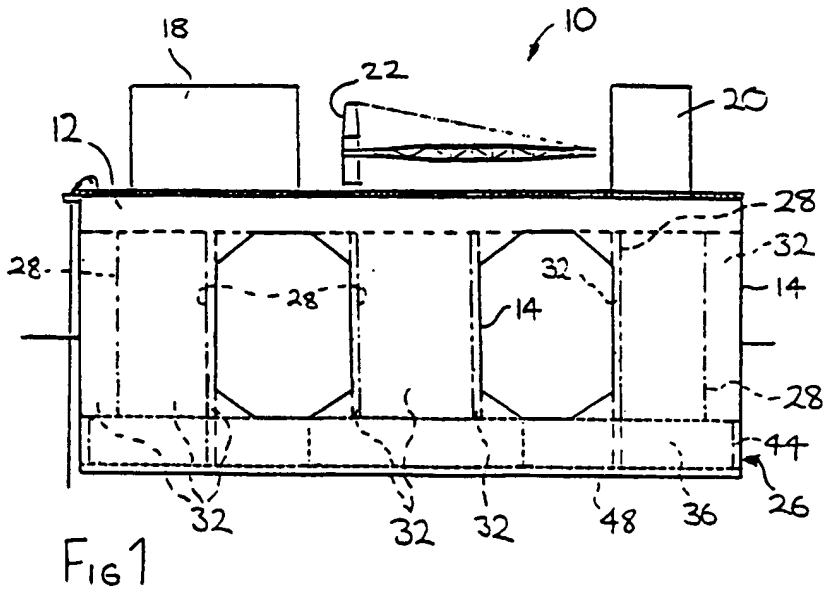

Fig 1

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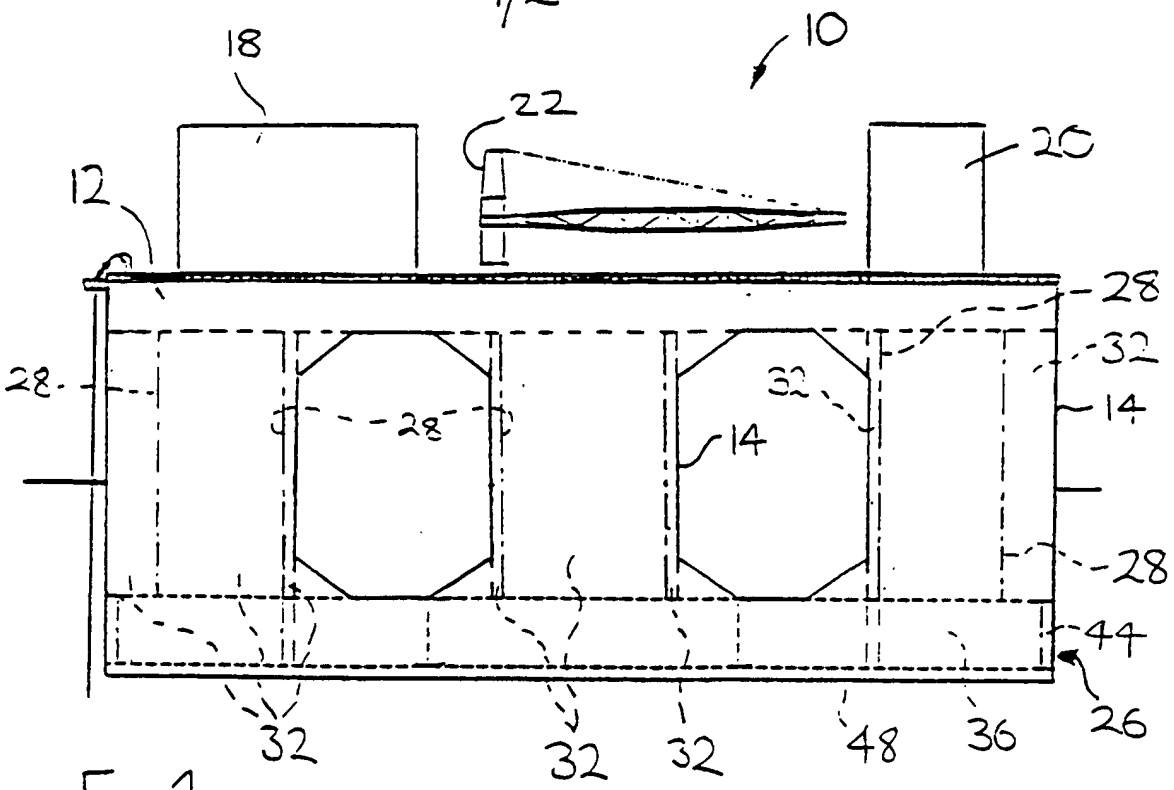
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FIG 1

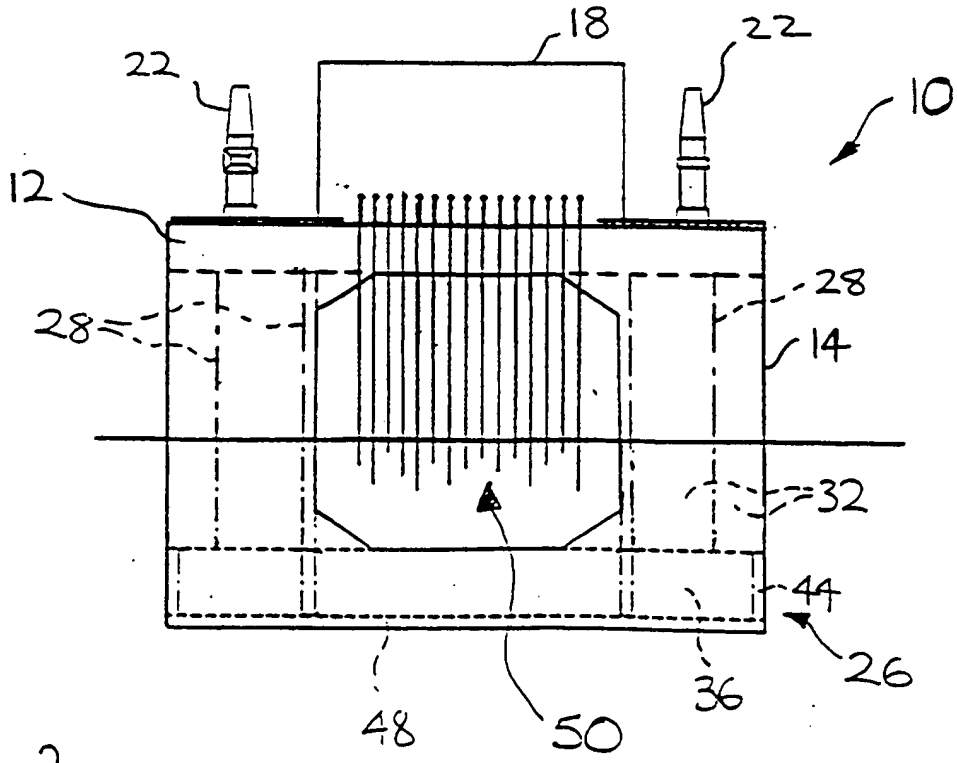
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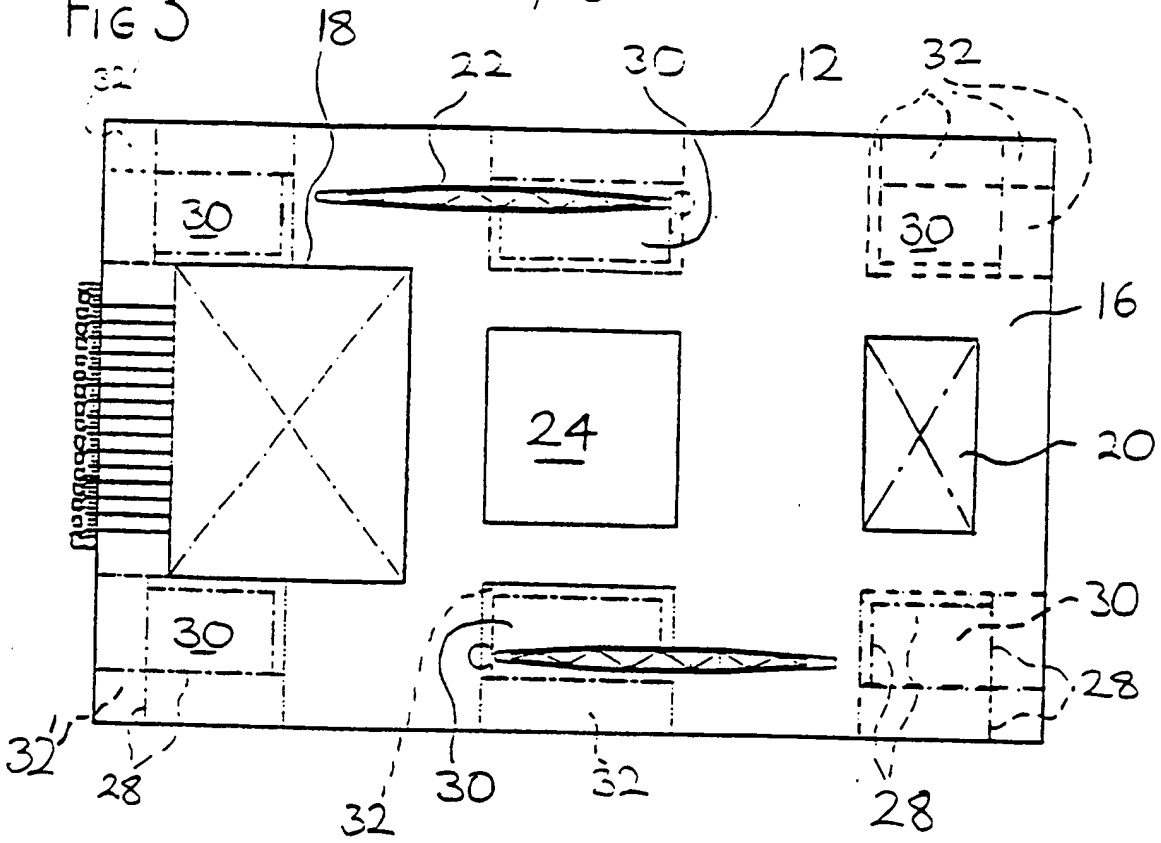
FIG 2

FIG 3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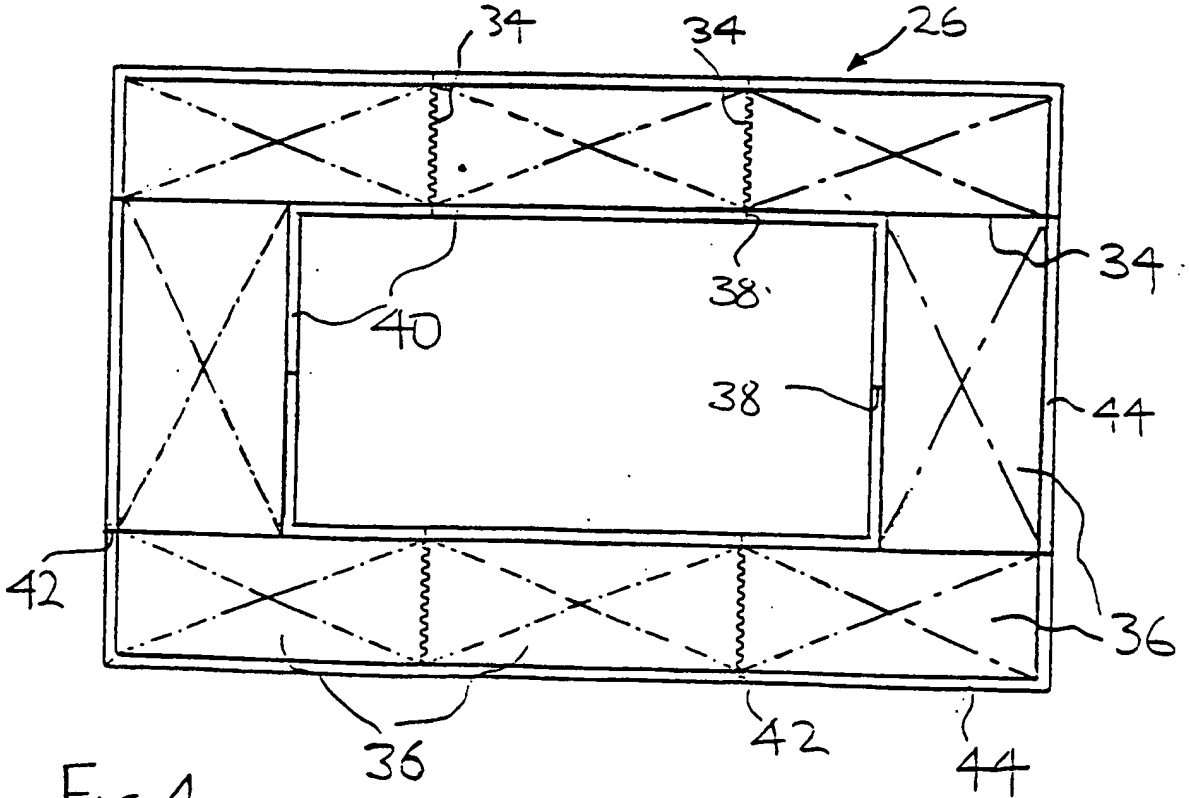
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FIG 4

SEMI-SUBMERSIBLE VESSELS

The invention relates to semi-submersible vessels.

The invention provides a semi-submersible vessel for storing liquid hydrocarbons, said vessel comprising a superstructure, a plurality of spaced apart legs extending from said superstructure, each said leg being divided by internal wall means which define storage tank means spaced radially inwardly of the respective leg, means rigidly interconnecting end portions of said legs disposed remote from said superstructure and means for communicating liquid hydrocarbons to said storage tank means.

Advantageously, the storage tank means are spaced further from portions of the respective said leg which face outwardly of the vessel than from inwardly facing portions of the leg.

Preferably, the storage tank means are spaced approximately four times further from said outwardly facing portions than from said inwardly facing portions.

Preferably, the internal wall means cooperate with the respective said leg to define ballast tank means adapted to receive sea-water ballast whereby said storage tank means are at least partially

enclosed in radial directions of the leg by said ballast tank means.

Preferably, the storage tank means extend substantially over the whole length of the respective said leg.

Preferably, the interconnecting means comprises tubular means which define a closed loop pontoon structure.

Preferably, the tubular means define further storage tank means disposed generally centrally thereof, said further storage tank means being adapted to receive liquid hydrocarbons via said communicating means.

Preferably, the tubular means further define inner ballast tank means disposed to one side of said further storage tank means and outer ballast tank means disposed to the side of said further storage tank means opposite said one side, said inner and outer ballast tanks means being adapted to receive sea-water ballast.

Preferably, the tubular means further define lower ballast tank means disposed below said further storage tank means.

The lower ballast tank means may be adapted to receive sea-water ballast. Alternatively, the lower ballast tank means may house a ballast having a

density greater than sea-water.

Preferably, said tubular means have a generally rectangular cross-section.

Preferably, said storage tank means of the legs and said further storage tank means provide a storage capacity of at least 75,000 cubic metres.

Preferably, said legs have a generally rectangular cross-section.

In order that the invention may be well understood, an embodiment thereof, which is given by way of example only, will now be described with reference to the drawings, in which:

Figure 1 is a side view of a semi-submersible vessel;

Figure 2 is an end view of the vessel looking from the left in Figure 1;

Figure 3 is a plan view of the vessel; and

Figure 4 is a plan view of a ring pontoon portion of the vessel.

Referring to Figures 1 to 4, a semi-submersible vessel 10 comprises a superstructure 12 and six spaced apart legs 14 extending from the superstructure. The superstructure defines a deck 16 on which supports a process and utilities module 18, a helicopter landing pad 20 and gantry cranes 22. A moonpool 24 is provided in the deck 18. The moonpool 24 provides an

access route to the seabed for drilling apparatus (not shown) allowing the vessel to be used for exploration purposes.

In plan, the superstructure 12 has a rectangular shape. A leg 14 is provided at each corner of the superstructure and at an intermediate position on the two longest sides of the vessel as best seen in Figure 3. The legs 14 are interconnected by rectangular cross-section tubular means which define a closed loop pontoon structure hereinafter referred to as ring pontoon 26. In plan view the ring pontoon 26 has a rectangular outline substantially coextensive with the rectangular superstructure 12.

As shown in Figure 3, the legs 14 which have a rectangular cross-section are each divided by internal walls 28 which define storage tank means 30 for liquid hydrocarbons. The storage tank means 30 extend over the whole length of and are spaced radially inwardly of the respective leg 14. In practice the storage tank means 30 are each sub-divided into a number of separate storage tanks by means of oiltight bulkheads and these tanks are preferably further divided by wash bulkheads. The oiltight bulkheads and wash bulkheads are omitted from the drawings merely to improve the clarity thereof.

The internal walls 28 cooperate with the walls

defining the respective legs to define sea-water ballast tank means 32 which extend over the whole length of the legs and enclose the storage tank means 30. The ballast tank means 32 are subdivided into separate ballast tanks by means of watertight bulkheads and these tanks are preferably further divided with wash bulkheads. Again, these features which will be familiar to the skilled person have been omitted from the drawings to improve the clarity thereof.

Referring to Figure 3, it will be noted that the storage tank means 30 are spaced further from portions of the respective leg 14 which face outwardly of the vessel 10 than from inward facing portions of the leg. In the embodiment, the storage tank means are spaced approximately four times further from said outwardly facing portions than from said inwardly facing portions.

Although the storage tank means 30 are illustrated as being completely enclosed in radial directions of the legs by the ballast tank means 32, it is envisaged that one or more of the legs will include a passage extending between the superstructure and the pontoon to provide an access route for ducting such as vent pipes and cargo lines and for control lines for the valves and pumps associated with the

ballast and storage tanks. Such a passage may for example be defined in the zone 32′ indicated in Figure 3.

Referring to Figure 4, the ring pontoon 26 defines further storage tank means for liquid hydrocarbons disposed generally centrally thereof and forming a closed loop within the pontoon. The further storage tank means is divided by oiltight bulkheads 34 to define eight separate storage tanks 36. The ring pontoon further defines inner and outer sea-water ballast tank means which are disposed on either side of the storage tanks 36. The inner ballast tank means is subdivided by watertight bulkheads 38 to define six separate ballast tanks 40. Likewise, the outer ballast tank means is subdivided by watertight bulkheads 42 to define eight separate ballast tanks 44. The storage tanks 36 are sandwiched between the inner ballast tanks 40 and the outer ballast tanks 44.

The ring pontoon 26 further defines a lower sea-water ballast tank means 48 disposed below the further storage tanks 36. The lower ballast tank means 48 extends over the entire lower, base, region of the pontoon. The lower ballast tank means 48 is preferably adapted to receive sea-water but may instead, or as well as, be used to house a permanent ballast having a density greater than sea-water such

as, for example, concrete or drilling mud.

The further storage tanks 36, inner ballast tanks 40, outer ballast tanks 44 and lower ballast tanks 48 are preferably subdivided by wash bulkheads (not shown) in order to reduce the effect of surging of the liquid hydrocarbons or sea-water stored therein particularly when the tank is in a partially full, or so-called slack, condition.

It will be appreciated that the further storage tanks 36 are enclosed on three sides thereof by the combination of the inner ballast tanks 40, outer ballast tanks 42 and lower ballast tank means 48.

The legs 14 and ring pontoon 26 can be of a simple stiffened plate construction suitable for panel line assembly/construction techniques making use of automatic and semi-automatic welding processes.

Liquid hydrocarbons are conveyed from the seabed to the processing and utilities module 18 via a plurality of risers 50. Cargo filling lines (not shown) are provided for conveying the produced liquid hydrocarbons from the process and utilities module 18 to the storage tank means 30 and storage tanks 36.

The ballast tank means 32, inner and outer ballast tanks 40, 44 and lower ballast tank means 48 are interconnected by means of a ring main (not shown) with ballasting to be by means of hydraulically driven

submerged pumps. During cargo off-loading, sea water ballast is able to gravitate into the ballast tanks 40, 44 by means of one-way valves (not shown) to maintain stability of the vessel 10, pump operation is not required to fill the ballast tanks.

The vessel is trimmed by ballasting the ballast tank means 32 in the legs 14 by means of remote hydraulically or pneumatically operated valves (not shown).

The vessel is provided with a fluid management system such as the Simrad AVM Fluid Management System or the like to monitor and control on board liquids; ie. sea-water ballast, liquid hydrocarbons and bilge.

The storage tank means 30 in the legs 14 and the storage tanks 36 in the ring pontoon 26 provide the vessel 10 with a substantial storage capacity for liquid hydrocarbons. It is envisaged that in practice the vessel 10 will have a storage capacity of approximately 79,000 m^3 (500,000 bbls) which is roughly equivalent to 69,000 tonne of crude oil at 0.875 specific gravity.

In addition to the high storage capacity provided by the vessel, it will be appreciated that the liquid hydrocarbons storage tanks are spaced from external walls of the vessel and in particular from external walls which may suffer damage in use, for example by

collision with a tanker which is loading cargo from the vessel, reducing the likelihood of spillages of the liquid hydrocarbons cargo from the vessel. It is considered that the faces of the legs 14 which face outwardly of the vessel are most prone to damage and to provide additional protection for the storage tanks in the legs, these tanks are spaced further from these outward facing portions of the legs than from the inward facing portions thereof.

Whilst one aspect of the invention is claimed in claim 1 of this specification, it is to be understood that in other aspects the invention may include any novel integer or combination of integers disclosed herein whether the subject of the claims or not.

CLAIMS:

1. A semi-submersible vessel for storing liquid hydrocarbons, said vessel comprising a superstructure, a plurality of spaced apart legs extending from said superstructure, each said leg being divided by internal wall means which define storage tank means spaced radially inwardly of the respective leg, means rigidly interconnecting end portions of said legs disposed remote from said superstructure and means for communicating liquid hydrocarbons to said storage tank means.

2. A vessel as claimed in claim 1, wherein said storage tank means are spaced further from portions of the respective said leg which face outwardly of the vessel than from inwardly facing portions of the leg.

3. A vessel as claimed in claim 2, wherein said storage tank means are spaced approximately four times further from said outwardly facing portions than from said inwardly facing portions.

4. A vessel as claimed in claim 1, 2 or 3 wherein said internal wall means cooperate with the respective said leg to define ballast tank means adapted to receive sea-water ballast whereby said storage tank

means are at least partially enclosed in radial directions of the leg by said ballast tank means.

5. A vessel as claimed in any one of claims 1 to 4, wherein said storage tank means extend substantially over the whole length of the respective said leg.

6. A vessel as claimed in any one of the preceding claims, wherein said interconnecting means comprises tubular means which define a closed loop pontoon structure.

7. A vessel as claimed in claim 6 wherein said tubular means define further storage tank means disposed generally centrally thereof, said further storage tank means being adapted to receive liquid hydrocarbons via said communicating means.

8. A vessel as claimed in claim 7, wherein said tubular means further define inner ballast tank means disposed to one side of said further storage tank means and outer ballast tank means disposed to the side of said further storage tank means opposite said one side, said inner and outer ballast tanks means being adapted to receive sea-water ballast.

9. A vessel as claimed in claim 7 or 8, wherein said

tubular means further define lower ballast tank means disposed below said further storage tank means.

10. A vessel as claimed in claim 9, wherein said lower ballast tank means is adapted to receive sea-water ballast.

11. A vessel as claimed in claim 9, wherein said lower ballast tank means houses a ballast having a density greater than sea-water.

12. A vessel as claimed in any one of claims 7 to 11, wherein said tubular means have a generally rectangular cross-section.

13. A vessel as claimed in any one of claims 7 to 12, wherein said storage tank means of the legs and said further storage tank means provide a storage capacity of at least 75,000 cubic metres.

14. A vessel as claimed in any one of the preceding claims, wherein said legs have a generally rectangular cross-section.

15. A vessel substantially as hereinbefore described with reference to the drawings.

UK Patent Office

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Application No: GB 9604131.4
Claims searched: 1-15

Examiner: Alan Habbijam
Date of search: 7 March 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B7A (AAAQ, ACA, A430A) : EIH (HB)

Int Cl (Ed.6): B63B 25/08, 25/10, 25/12, 35/44 : B65D 88/78

Other: Online:WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2292349 A	(DEILDOK) see Figs 1-3 and related description on pages 3&4.	1,4-7&12.
A	GB 2121733 A	(GOTAVERKEN ARENDAL) see Figs 1&2 in particular.	1.
A	GB 1585922	(MOBIL OIL) see Figs 2-6 in particular.	1.

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
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